

STUDIES ON THE ENDOCOMMENSAL CILIATE FAUNA OF CARIBBEAN SEA URCHINS

IRA JONES AND THOMAS E. ROGERS

Department of Biology, Inter American University of Puerto Rico, San Germán, P. R. 00753

From a review of the literature, it appears that Jacobs (1914) initiated studies on intestinal ciliates of American sea urchins. During the past 50 years, several investigators have made contributions on the ciliate fauna of sea urchins of the Western Hemisphere; thus almost two dozen species of ciliates have been described from the echinoids. Much of the early work was conducted on sea urchins of Bermuda. Ball (1924) started studies on ciliates of *Diadema* sp. and *Echinometra* sp. of Bermuda and suggested new names for five species of ciliates which she observed; but she never named them. At the request of the Director of the Bermuda Biological Station, Dr. D. H. Wenrich prepared a publication on some of the results of Miss Ball's (now Mrs. Ruth Ball Biggar) study. In the paper of Biggar and Wenrich (1932), the ciliates *Metopus circumlabens* found in *Diadema setosum* and *Echinometra subangularis*, *Cryptochilum bermudensis* in *Toxopneustes variegatus*, *Cryptochilum echinometris* of *Echinometris subangularis*, and *Anophrys elongata* found in both *Toxopneustes variegatus* and *Echinometris subangularis* were described. Lucas (1934) described *Metopus rotundus* found in *Diadema setosum* at Bermuda. Since then, several reports have been given on

TABLE I
Frequency of ciliates in echinoids of Puerto Rico

Host	Ciliates							Total number specimens examined
	<i>Anophrys aglycus</i>	<i>Anophrys elongata</i>	<i>Biggaria bermudensis</i>	<i>Biggaria echinometris</i>	<i>Cohni-lembus caeci</i>	<i>Cyclidium rhabod- tectum</i>	<i>Metopus circum- ladens</i>	
<i>Diadema antillarum</i>		10 —	38 ++				26 ++	38
<i>Echinometra lucunter</i>		40 ++	36 ++	8 —		21 +	49 ++	59
<i>Lytechinus variegatus</i>	12 +	42 ++	35 ++	10 —		9 ++	34 +	46
<i>Triplonectes ventricosus</i>		16 —	34 ++	4 —	31 +	33 ++	30 +	53

The numbers given in the columns under ciliates in each of the Tables I-V represent the number of hosts found infested with the indicated ciliate; ++ = very abundant, + = many and — = few.

TABLE II
Frequency of ciliates in echinoids of Curacao

Host	Ciliates							Total number specimens examined
	<i>Anophrys aglycus</i>	<i>Anophrys elongata</i>	<i>Biggaria bermudensis</i>	<i>Biggaria echinometris</i>	<i>Cohnilembus caeci</i>	<i>Cyclidium rhabdotectum</i>	<i>Metopus circumlabens</i>	
<i>Diadema antillarum</i>	4+	1+	6+			6+	8+	8
<i>Echinometra lucunter</i>	4+	3+	2++			2+	2+	6
<i>Lytechinus variegatus</i>	1-	1+	1++					1
<i>Tripneustes ventricosus</i>	8+	8++	3+	1-	3+	1-	3+	12

endocommensal ciliates of echinoids inhabiting the waters of the Atlantic, Gulf, and the Pacific Coasts of North America (Powers, 1933, 1935; Berger, 1960; Berger and Profant, 1961; Beers, 1948, 1954, 1961; Lynch, 1929).

In South America, Urdaneta-Morales and Tengler de McLure (1966) studied the ciliates of *Echinometra lucunter*, *Diadema antillarum*, *Tripneustes ventricosus* and *Eucidaris tribuloides* of the Federal District of Venezuela. It appears that the report of Berger (1961) on the ciliates of *Diadema antillarum*, *Clypeaster rosaceus*, *Echinometra lucunter*, *Lytechinus variegatus*, and *Tripneustes ventricosus* of Bimini Islands, Bahamas, is the only information available on endocommensal ciliates of sea urchins inhabiting between Bermuda and South America. Because there seemed not to have been any major studies on ciliates of sea urchins between Bimini and Venezuela, a survey was commenced in early January, 1968, to compare the ciliate fauna of sea urchins in this area of the Caribbean with the

TABLE III
Frequency of ciliates in echinoids of St. Croix

Host	Ciliates							Total number specimens examined
	<i>Anophrys aglycus</i>	<i>Anophrys elongata</i>	<i>Biggaria bermudensis</i>	<i>Biggaria echinometris</i>	<i>Cohnilembus caeci</i>	<i>Cyclidium rhabdotectum</i>	<i>Metopus circumlabens</i>	
<i>Diadema antillarum</i>			10++		1-	3+	10++	10
<i>Echinometra lucunter</i>		4+				1+	3++	4
<i>Tripneustes ventricosus</i>		6++	6++		1-	2+	3++	11

TABLE IV
Frequency of ciliates in echinoids of St. Thomas

Host	Ciliates							Total number specimens examined
	<i>Anophrys aglycus</i>	<i>Anophrys elongata</i>	<i>Biggaria bermudensis</i>	<i>Biggaria echinometris</i>	<i>Cohni-lembus caeci</i>	<i>Cyclidium rhabdo-lectum</i>	<i>Metopus circum-labens</i>	
<i>Diadema antillarum</i>		4+	10++		1-	3+	10++	10
<i>Triplonustes ventricosus</i>		6++	6++		1-	2+	3++	11

reports on Bimini and Venezuela. This report concerns the results from studies on the endocommensal ciliates found in four species of sea urchins collected from the Caribbean Sea at St. Thomas, St. Croix of the Virgin Islands, Curacao, Netherlands Antilles, Vieques, and with major emphasis on samples taken from the southwestern coast of Puerto Rico.

MATERIALS AND METHODS

Samples of sea urchins, *Echinometra lucunter*, *Diadema antillarum*, *Lytechinus variegatus*, and *Triplonustes ventricosus*, were collected from the littoral in the Caribbean at five islands. Specimens were taken from Brewers Bay at St. Thomas, St. Croix near Buck Island, the Piscardera Bay at Curacao, Vieques, and the southwestern coast of Puerto Rico. In this survey 282 sea urchins were collected at a depth not greater than four feet.

The specimens were examined for intestinal ciliates immediately, or on an average within eight hours after collecting. The method of examination was essentially as described by Lucas (1934). Studies were made primarily on living ciliates, observed both by bright-field and phase contrast microscopy. In a few cases, a dilute solution (1:10,000) of Lugol's iodine was employed as a supra-

TABLE V
Frequency of ciliates in echinoids of Vieques

Host	Ciliates							Total number specimens examined
	<i>Anophrys aglycus</i>	<i>Anophrys elongata</i>	<i>Biggaria bermudensis</i>	<i>Biggaria echinometris</i>	<i>Cohni-lembus caeci</i>	<i>Cyclidium rhabdo-lectum</i>	<i>Metopus circum-labens</i>	
<i>Echinometra lucunter</i>	1+	4+		4-		2+	2++	5
<i>Lytechinus variegatus</i>	1+	3+	6++			1+		6
<i>Triplonustes ventricosus</i>			2+				1+	2

TABLE VI
Comparative distribution of ciliates

Host	Ciliates						
	<i>Anophrys aglycus</i>	<i>Anophrys elongata</i>	<i>Biggaria bermudensis</i>	<i>Biggaria echinometris</i>	<i>Cohnilembus caeci</i>	<i>Cyclidium rhabdolectum</i>	<i>Metopus circumtabens</i>
<i>Diadema antillarum</i>	—	B	B	B	—	—	B
	V	—	V	—	V	V	V
	—	P	P	—	—	—	P
<i>Echinometra lucunter</i>	—	B	B	B	—	—	B
	V	V	V	V	V	V	V
	—	P	P	P	—	P	P
<i>Lytechinus variegatus</i>	—	B	B	B	—	—	—
	P	P	P	P	—	P	P
<i>Tripneustes ventricosus</i>	—	B	B	B	—	—	—
	V	V	V	V	V	V	V
	—	P	P	P	P	P	P

For each host, indication is given for report of individual ciliates at Bimini (Berger, 1961), Venezuela (Urdaneta-Morales and Tengler de McLure, 1966), and Puerto Rico (the present report).

B = Bimini
V = Venezuela
P = Puerto Rico
— = The species was not reported

vital stain. For more detailed morphological studies some of the ciliates were fixed in Schaudinn's fluid, stained in Heidenhain iron hematoxylin, and mounted in Kleermount xylene solution.

RESULTS

Examinations of intestinal samples from the stated echinoid hosts observed in this study revealed that at least seven ciliates live as endocommensals in the Caribbean. The hosts and ciliates are given in Tables I–V. At St. Croix, *Lytechinus variegatus* was not found in the collecting area, while at St. Thomas, *Lytechinus variegatus* and *Echinometra lucunter* were not found in the area. *Diadema antillarum* was not obtained from the collecting area at Vieques.

DISCUSSION

In Table VI, the results of the present study, Puerto Rico only, have been compared with the reports of Berger (1961), and Urdaneta-Morales and Tengler de McLure (1966) on the intestinal ciliates of sea urchins of Bimini and Venezuela, respectively. Because *Lytechinus variegatus* was not included in the study by Urdaneta-Morales and Tengler de McLure (1966), only the ciliates of Bimini and Puerto Rico can be compared for this sea urchin.

It is of interest to note that *Anophrys aglycus* was reported for *Diadema*

antillarum, *Echinometra lucunter* and *Tripneustes ventricosus* of Venezuela but not for the same species at Bimini and Puerto Rico. This ciliate was found in *Lytechinus variegatus* at Puerto Rico, and likewise in *Echinometra lucunter* at Vieques. At Curacao, *Anophrys aglycus* was found in four species of sea urchins. In general, the seven ciliates given in this report are found in two or more species of sea urchins from Bimini, through the Caribbean to South America. There are considerable variations in the ciliate fauna and their abundance at different localities; likewise significant variations in hosts' abundance were observed. Thus it may well be that the diet of the host and the abundance of species living in association may be factors involved in the distribution of endocommensal ciliates.

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SUMMARY

Two hundred and eighty-two sea urchins, *Diadema antillarum*, *Echinometra lucunter*, *Lytechinus variegatus*, and *Tripneustes ventricosus*, collected from the littoral in the Caribbean were examined for intestinal ciliates. The specimens were collected from the islands, St. Thomas, St. Croix, Curacao, Vieques, and with major emphasis, the southwestern coast of Puerto Rico. Studies were made primarily on living ciliates with the exception of a few specimens fixed in Schaudinn's fluid and stained with iron hematoxylin; seven ciliates were found: *Anophrys aglycus*, *Anophrys elongata*, *Biggaria bermudensis*, *Biggaria echinometris*, *Cohnilembus caeci*, *Cyclidium rhabdotectum*, and *Metopus circumlabens*.

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